REMARKS/ARGUMENTS

Claims 1-12 and 20-26 have been previously withdrawn. Claims 13, 17, 27 and 31 have been amended by the Amendment. Claims 13-19 and 27-32 are currently pending in the application, are rejected, and are at issue.

§ 102 Claim Rejections - U.S. Patent No. 6,562,633

Claims 13-19 and 27-32 stand rejected under §§ 102(a) and/or 102(e) as anticipated by U.S. Patent No. 6,602,620 to Kikitsu et al. ("Kikitsu"). Applicants respectfully traverse the Examiner's rejections for at least the following reasons.

Independent claim 13, as amended, recites a magnetic recording disc for magnetic recording, which includes "*a disc substrate having a locking pattern formed therein, the locking pattern comprising a plurality of pits formed in the disc substrate; and a plurality of nanoparticles completely filling each of the plurality of pits and exhibiting short-range order characteristics.*" Similarly, independent claim 27 recites a data storage medium for magnetic recording, which includes "*a substrate having a locking pattern formed therein, the locking pattern comprising a plurality of pits formed in the substrate; and a plurality of nanoparticles completely filling each of the plurality of pits and exhibiting short-range order characteristics.*" Kikitsu neither teaches nor suggests these limitations.

Kikitsu discloses a magnetic recording medium formed using a self-organized block copolymer mask. As taught by Kikitsu, a continuous non-magnetic film is deposited on a substrate, and a self-organized mask having regularly arrayed holes is displaced on the continuous non-magnetic film. Holes are etched in the continuous non-magnetic film through the mask, and a magnetic material is deposited in the holes, thereby forming magnetic particles.

(Kikitsu, col. 6, lns. 21-30). As shown in Fig. 13 of Kikitsu and the corresponding description, each of the holes formed in the continuous non-magnetic film is formed to receive one magnetic particle. Thus, Kikitsu teaches a magnetic recording medium having regularly arrayed magnetic particles displaced in a non-magnetic film, with each of the particles spaced from one another and separated by the non-magnetic film. (Kikitsu, Fig. 13). This structure of magnetic particles in a non-magnetic matrix can also be manufactured by applying a self-organized mask on top of a continuous layer of magnetic material. The magnetic material is etched to form the magnetic particles, and a non-magnetic film is deposited in the region between the magnetic particles. (Kikitsu, col. 6, lns. 31-42).

Kikitsu also teaches a reverse-type structure, where a continuous magnetic film is deposited on the substrate, and regularly arrayed holes are etched in the magnetic film using the self-organized mask. A non-magnetic material is deposited in the holes, thereby forming non-magnetic particles. (Kikitsu, col. 6, lns. 43-52). As shown in Fig. 14 of Kikitsu and the corresponding description, each of the holes formed in the continuous magnetic film is formed to receive one non-magnetic particle. Thus, Kikitsu also teaches a magnetic recording medium having regularly arrayed non-magnetic particles displaced in a magnetic film, with each of the particles spaced from one another and separated by the magnetic film. (Kikitsu, Fig. 14). This structure of non-magnetic particles in a magnetic matrix can also be manufactured by applying a self-organized mask on top of a continuous layer of non-magnetic material. The non-magnetic material is etched to form the non-magnetic particles, and a magnetic film is deposited in the region between the non-magnetic particles. (Kikitsu, col. 5, ln. 52 thru col. 6, ln.8; and col. 19, ln. 65 thru col. 20, ln. 14).

In contrast, independent claims 13 and 27 recite a substrate having a locking pattern formed therein, with the locking pattern comprising a plurality of pits formed in the substrate, and a plurality of nanoparticles completely filling each pit and exhibiting short-range order characteristics. There is no locking pattern of any type formed in the substrate of Kikitsu, and Kikitsu does not teach or suggest any physical modification to the substrate. As previously noted, Kikitsu discloses a continuous non-magnetic film deposited on the substrate, and holes etched in the non-magnetic film in a predetermined array, with each hole having one magnetic particle therein. Additionally, particles *per se* are not placed in the holes formed in the non-magnetic film, but rather, a magnetic material is deposited into the holes, with the magnetic material thereby forming a magnetic particle in each of the holes.

Independent claims 13 and 27, as amended, require that the locking pattern formed in the substrate comprise a plurality of pits formed therein, with a plurality of nanoparticles completely filling each of the plurality of pits and exhibiting short-range order characteristics. The short-range order characteristics exhibited by the nanoparticles are such that the nanoparticles will form an ordered structure across a short length scale. The locking pattern is formed in the substrate according to the self-assembly coherence length scale of the nanoparticles and, accordingly, the nanoparticles self-assemble therein forming self organized magnetic arrays and planarizing the substrate surface. The self-assembly of the nanoparticles that is due to their short-range order characteristics is influenced by the nature of the interactions exhibited among the nanoparticles, such as, but not limited to, ionic bonds, hydrogen bonds and van der Waals interactions. This self-assembly of nanoparticles due to their short-range order characteristics, as recited in independent claims 13 and 27, is distinctly different from the one particle to one hole approach as taught by Kikitsu.

Kikitsu includes no teaching or suggestion of depositing a plurality of nanoparticles in a hole. Kikitsu must fill every hole with an atomic deposition process (sputter, evaporation, electroplating, *etc.*) which completely fills each hole, *i.e.*, there is a one-to-one correspondence of hole and particle. Kikitsu in fact teaches away from a plurality of particles to a hole by requiring that the average distance between the magnetic particles in the non-magnetic matrix be 1 nm or more to alleviate magnetic reversal caused by adjacent particles. (Kikitsu, col. 11, lns. 43-48). Kikitsu includes no description of how to place multiple particles inside a hole and, in fact, teaches directly away from such a concept by requiring that the magnet particles be spaced from one another by a minimum distance. As previously noted, the self-assembly of multiple nanoparticles in a hole or pit requires that the short-range characteristics of the nanoparticles be taken into account. The short-range order characteristics are influenced by the nature of the interactions exhibited between nanoparticles. Kikitsu is completely devoid of particle interactions and specifically teaches to avoid such interactions by requiring a minimum distance between the magnetic particles. Kikitsu thus does not teach or suggest the limitations recited in independent claims 13 and 27.

Accordingly, for at least the above-identified reasons, Applicants submit that independent claims 13 and 27 are allowable over Kikitsu.

Claims 14-19 and 28-32 depend cognately from independent claims 13 and 27, respectively, recite further structural detail further delineating over the prior art, and are also believed allowable.

<u>§ 102 Claim Rejections - U.S. Patent No. 6,162,532</u>

Claims 13-16, 18-19, 27-30 and 32 stand rejected under §§ 102(a) and/or 102(e) as anticipated by U.S. Patent No. 6,162,532 to Black et al. ("Black"). Applicants respectfully traverse the Examiner's rejections for at least the following reasons.

Independent claim 13, as amended, recites a magnetic recording disc for magnetic recording, which includes "*a disc substrate having a locking pattern formed therein, the locking pattern comprising a plurality of pits formed in the disc substrate; and a plurality of nanoparticles completely filling each of the plurality of pits and exhibiting short-range order characteristics.*" Similarly, independent claim 27, as amended, recites a data storage medium for magnetic recording, which includes "*a substrate having a locking pattern formed therein, the locking pattern comprising a plurality of pits formed in the substrate; and a plurality of nanoparticles completely filling each of the plurality of pits and exhibiting short-range order characteristics.*" Black neither teaches nor suggests these limitations.

Black discloses a chemical patterning method to form a magnetic storage medium. Black teaches the use of an affinity layer applied to the substrate, with the affinity layer composed of an affinity material adapted to attract and retain the particles. As shown in Fig. 7 of Black, the affinity layer 6 is applied to the substrate 5 in a preselect pattern. The particles 1 are then applied to the substrate 5, where they are attracted to, and are retained on, the affinity layer 6. There is no locking pattern of any type formed in the substrate of Black, and Black does not teach or suggest any physical modification to the substrate. Such a chemical patterning as taught by Black is distinctly different from the claimed invention.

Both independent claims 13 and 27 recite that the locking pattern includes a plurality of pits formed in the substrate, with a plurality of nanoparticles completely filling each of the

plurality of pits and exhibiting short-range order characteristics. The short-range order characteristics exhibited by the nanoparticles are such that the nanoparticles will self-assemble and form an ordered structure across a short length scale. The self-assembly of the nanoparticles that is due to their short-range order characteristics is influenced by the nature of the interactions exhibited among the nanoparticles, such as, but not limited to, ionic bonds, hydrogen bonds and van der Waals interactions. This self-assembly of nanoparticles due to their short-range order characteristics, as recited in independent claims 13 and 27, is distinctly different from the chemical patterning method taught by Black where the particles are attracted to and retained on an affinity layer. Black does not teach or suggest the limitations recited in independent claims 13 and 27.

Accordingly, for at least the above-identified reasons, Applicants submit that independent claims 13 and 27 are allowable over Black.

Claims 14-16, 18-19, 28-30 and 32 depend cognately from independent claims 13 or 27, recite further structural detail further delineating over the prior art, and are also believed allowable.

§ 103 Claim Rejections

Claims 17-18 and 31-32 stand rejected under § 103(a) as obvious in view of Black, and further in view of Kikitsu. Applicants respectfully traverse the Examiner's rejections for at least the following reasons.

Claims 17-18 and 31-32 depend from independent claims 13 and 27, respectively. The deficiencies of Kikitsu and Black with respect to the independent claims have been previously

noted. Since the individual references are deficient, any combination thereof is also deficient. Accordingly, claims 17-18 and 31-32 are believed allowable over the prior art.

Conclusion

In summary, neither Kikitsu nor Black teach or suggest a substrate having a locking pattern formed therein, the locking pattern comprising a plurality of pits formed in the substrate, and a plurality of nanoparticles completely filling each of the plurality of pits and exhibiting short-range order characteristics.

Thus, for at least the above-identified reasons, Applicants submit that claims 13-19 and 27-32 are allowable over the prior art of record. Reconsideration of pending claims 13-19 and 27-32, allowance and passage to issue are respectfully requested.

It is believed that this Amendment requires no fee. However, if a fee is required for any reason, the Commissioner is hereby authorized to charge Deposit Account No. 02-4553 the necessary amount.

Respectfully submitted,

Dated: 8-6-2004

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